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PALEONTOLOGICAL NOTES, NO. V.

A NEW FOSSIL CRAB FROM THE MIOCENE GREENSAND
BED OF GAY HEAD, MARTHA'S VINEYARD, WITH
REMARKS ON THE PHYLOGENY OF THE GENUS
CANCER.

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Received May 3, 1900. Presented May 9, 1900.

IN looking over a small collection of fossil crabs made by Mr. J. H. Clarke of Providence, R. I., about thirty years ago, there occurred one specimen which represented quite a different group from Stimpson's *Archaeoplax signifera*. It came, he told me, from the same bed and locality at Gay Head as the other crabs.

On consulting with Mr. Walter Faxon, assistant in charge of the Crustacea of the Museum of Comparative Zoölogy, who kindly showed me the fossil crabs of the collection, we concluded that though the body was very round and the surface of the carapace much more convex, it could not belong to any other genus. Mr. J. B. Woodworth also kindly allowed me to examine a trayful of fragments of *Archaeoplax* collected by him while connected with the U. S. Geological Survey, from the greensand bed at Gay Head. Among them was the hand of what was plainly enough that of a large Cancer, like our common *C. irroratus*, and it seemed evident that it must have belonged to a large individual of the same species as the small crab. Both still retained more or less of the greensand, and the hand was loosely embedded in a matrix of that material. For the opportunity of describing the hand, I am indebted to the U. S. Geological Survey.

Cancer proavitus, n. sp., Plate I., Figs. 1, 2, 3. One young male represented by the carapace, sternum, and basal joints of the legs. All the teeth on the front edge of the carapace absent except the two on the left side of the left orbit.

Body much narrower, and therefore rounder, more orbicular than in the existing species.

Carapace entire, with the exception of the greater part of the front margin. It is much higher and much more convex than in the two existing species of our coast (*C. irroratus* and *C. borealis*), being almost rounded, the convexity being between one-fourth and one-third the entire thickness of the body. The surface is much more irregular than in the two existing species, being thrown up into fourteen well-marked, more or less flattened, bosses or tuberosities. Of these, four are situated along the median line; the one most posterior is the broadest and highest, the fourth or most anterior one the smallest and lowest; also the granulations or crateriform papillæ covering the surface of all the tuberosities are larger and more prominent than those elsewhere on the surface of the carapace. On each side of the median row are five other flattened low tuberosities, the largest of which is opposite the second median one (counting from behind), and half-way between this and the outer side of the same tuberosities is a small one; behind the one first named is a small one situated opposite to the first (or most posterior) median tuberosity. In front there are two small tuberosities, situated opposite the anterior median one, but placed a little nearer the front edge, and directly behind the orbit or base of the eyestalk; of these two bosses the outer one is the larger.

Fortunately on the left side of the left orbit two of the marginal teeth of the carapace are perfectly preserved; they correspond to the second and third teeth, from the left orbit, of *C. irroratus*. The third tooth (corresponding to the third tooth in *C. irroratus*) is straight on the free edge, with about 15 papillæ or granulations along the edge, while the other (the second) is more conical or tooth-like, with from 16 to 18 granulations; indeed the granulations on the edge and near it are almost exactly the same in number, size, and position as in *C. irroratus*.

The hinder edge of the carapace is much as in *C. irroratus*; the row of granulations on each side of the middle of the carapace, and the shorter oblique row extending to the insertions of the hinder pair of legs, are almost exactly as in the existing species. In the fossil species there are about four of these granulations to the millimetre, there being the same number in *C. irroratus*, at a point near the median line of the carapace; while in the middle of the series there are five, but in *C. irroratus* only three, being slightly larger and farther apart.

The sternum is as in the male *C. borealis*, as are the basal joints of the legs, and I can detect no good specific differences. In the sternum of the fossil species, the three segments, including the apical one, which ends at the insertion of the maxillipeds, are well preserved.

On the posterior edge of the penultimate sternal segment are two minute tubercles, but with the tips broken off, which are exactly as in *C. irroratus*; these little tubercles we take to be the "genital tubercles" of Stimpson. The abdomen itself is wanting. The sternum is on the whole rather more like that of *C. borealis* than *C. irroratus*.

The large hand evidently belonging to this species is marked in exactly the same manner on the outer aspect as in *C. borealis*, having the four distinct raised granulated lines or ridges, with the same arrangement as in the living species. The single specimen lacks the articular face at the base, as also unfortunately the fingers, and also the spine at the base.

Of the four ridges on the inner face, on the lowest ridge there are 32 papillæ, or conical granulations; on the ridge above, where they are much smaller, about 33; in the third ridge there are two rows of conical granulations, one consisting of 20 large ones, with a parallel row of minute ones below; on the fourth ridge there are about 12-14 large granulations, with smaller ones situated irregularly on the lower side, while some others are interpolated between the large ones. The concavities between the ridges are well marked.

Length of carapace, 30 mm.; width, 38 mm.

Thickness of the body in the middle, 17-18 mm.; amount of convexity of the dorsal surface of the carapace, about 5 mm.

Length of sternum, 20 mm.; greatest breadth, 12 mm.

Length of hand without the fingers, of the other specimen, 30 mm.; breadth, 21 mm.

On comparison with seven small *C. irroratus* (2♂ and 5♀) of nearly the same age, it is seen to differ markedly in three points, *i. e.*, the very narrow, much rounded, or orbicular body, the much more convex carapace, and the much greater number and prominence of the flattened tuberosities.

In the small *C. irroratus* 34 mm. long the carapace is 50 mm. in width, or 16 mm. wider; in *C. proavitus*, which is 30 mm. long, it is only 8 mm. wider than long.

In *C. irroratus* we see only traces of the tuberosities on the sides of the carapace, those of the median line being obsolete. On each side of the median line or region in *C. irroratus* are two obscurely marked tuberosities, but they are very low, broad, and flat. The most striking difference, however, is the much more rounded shape of the body. On the other hand, the teeth and granulations on the teeth, and on the narrow ridges of the posterior edge of the carapace, are nearly identical.

Comparing the hand of the fossil species from the U. S. Geological

Survey with that of a *Cancer irroratus* about four inches wide, notable differences are to be seen. Though the four ridges are the same in length, width apart, and in general arrangement, the teeth on these ridges are in *C. proavitus* very much larger, and are represented in *C. irroratus* by more numerous and crowded granulations, which are flattened, rounded, and polished.

In some important respects the tertiary species resembles *C. borealis*. This differs from *C. irroratus* in being finely muricate, the minute setiferous tubercles being much larger, higher, and sharper, almost forming sharp spines; they are also more numerous and crowded, and often bear a hair. In these respects *C. proavitus* approaches *C. borealis*. As in *C. irroratus*, the antero-lateral margins are nine-toothed; of these teeth the ninth, or that next to the orbit, is sharper than in the other living species, and ends in a sharp spine, with several accessory spinules. The postero-lateral margins are more sinuous than in *C. irroratus*, and the granulations on the ridge are larger, fewer, and end in a point. In both of the living species the convexity of the carapace is about the same. The surface in *C. borealis* is perhaps a little more uneven.

The hand of *C. borealis* differs from that of *C. irroratus* in being much more muricate or spiny, the granulations on the four external ridges of the latter being represented by well-marked sharp spines, these being especially large and high on the uppermost ridges.

C. borealis is a decidedly hairy species, whereas *C. irroratus* is naked, but a few hairs being visible; on the other hand, in *C. borealis* nearly every tubercle bears a pale hair.

The abdomen of *C. borealis* differs from that of the more common species (*C. irroratus*) in being less acute and mucronate at the tip. The sternum is a little more hairy.

Length of a small *C. borealis*, 30 mm.; breadth, 39 mm.; thickness of body, 10-11 mm.

The phylogeny of the Eastern American species of the genus Cancer. — A comparison of the miocene tertiary species of *Cancer* with the two species now living in the waters of Vineyard Sound, brings out the interesting fact that the extinct species appears to be the stem or ancestral form from which the recent species mentioned have descended.

Cancer proavitus presents characters in which it resembles *C. borealis* as well as *C. irroratus*. It resembles *C. borealis* in the higher, more pointed granulations on the postero-lateral margin of the carapace, and in the quite high and sharp spines on the ridges of the hand, as well as the numerous setiferous spines and hairs; on the other hand it is simi-

lar to *C. irroratus* in the shape of the nine teeth on the antero-lateral margin of the carapace, and in the straight postero-lateral margin of the same. It is rounder, narrower, the carapace more convex, and the body in general more hairy than either of the existing species.

It thus seems most probable that the miocene species, being a more generalized, composite form, is the ancestor from which either towards the end of the pliocene or the beginning of the quaternary period the two living species sprang. *C. irroratus* has inherited the exact shape of the lateral teeth, and the shape of the postero-lateral margin of *C. proavitus*, while *C. borealis* has retained the higher spine-like granulations or sub-muricate feature of the carapace and hand, and the hairiness of the body.

On the whole the evidence that our two northeastern species have descended from a much more rounded, convex, and hairy miocene form living in the same geographical area seems well established.

It would be most interesting to compare this fossil species with very young individuals of our living species, but after inquiry I find they are not in existence in our museums. It is to be hoped that specimens of the very young may be collected and compared with the fossil species. It is known that in *Cancer* the body grows wider with age.

Note on Archaeoplax signifera Stimpson.* — While the collections of the fossil Crustacea made at Gay Head comprise only one specimen of *Cancer proavitus*, with the hand of a much larger individual, the fragmentary remains of the *Archæoplax* are much more abundant, showing that it was the most prevalent form.

The specimens, however, in the Museum of Brown University, and those collected by Mr. Clarke, and those in the Cambridge Museum, are, so far as we have observed them, not sufficiently well preserved to enable one to make a restoration which would be a very decided improvement on the excellent diagrammatic drawings by Dr. Stimpson. None of the specimens of the carapace — and in two large specimens they are tolerably well preserved — show the four teeth of the antero-lateral margin; on the other hand, in Mr. Clarke's specimens the legs of the four posterior pairs are well enough preserved to show five of the joints, the terminal ones wanting; the fourth joints are of unusual length.

In one young specimen the carapace has been broken away on the back so as to still show the gills in place.

Regarding the temperature of the water of the miocene period at Gay

* On the fossil Crab of Gay Head, Boston Journal of Natural History, VII. No. 4, April, 1863.

Head Dr. Stimpson remarks: "The abundance of specimens of the *Archaeoplax* at Gay Head indicate a warm climate in that region at the time they were living. At the present day all Carcinoplasticæ are inhabitants of warm seas. The nearest allied genus, *Heteroplax*, lives on the coast of China at the northern limit of the torrid zone."

The occurrence of a species of *Cancer* in the same bed does not necessarily tend to prove that the water of the sea on our miocene coast was not somewhat warmer than at present, though not of subtropical temperature. There are four species of *Cancer* on the Pacific coast of North America, where *C. magister* ranges from Sitka to Monterey, *C. gracilis* from Puget Sound to San Francisco Bay, *C. productus* from Puget Sound to San Francisco, while *C. antennarius* occurs at San Francisco, Monterey, and Tomales Bay. I am indebted to Miss Mary J. Rathbun, assistant in the Smithsonian Institution, for the information that there are no tropical species of *Cancer*, and she has kindly sent me the following list of species of this genus exclusive of those of North America and Europe: —

- C. novae-zelandiae* Lucas. New Zealand.
- C. bellianus* Johnson. Madeira.
- C. plebeius* Poëppig. Chile.
- C. polyodon* " "
- C. edwardsii* Bell. "
- C. longipes* Bell. "
- C. japonicus* Ortmann. Japan
- C. pygmaeus* " "
- C. gibbosulus* (de Haan) " as well as west coast N. America.
- C. amphioetus* Rathbun " " " " " "

Of the two species now living on the shores of southern New England, the most common one (*C. irroratus*) ranges from southern Labrador to South Carolina, while *C. borealis* is rarer, more local, and has thus far only been found to extend from Nova Scotia to Vineyard Sound and No Man's Land. Both, then, appear to be on the whole boreal species.

The invertebrate fauna with which *Cancer proavitus* is associated has been enumerated by Dr. W. H. Dall.* Of twenty-two species of mollusks, about eight appear to be recent species still living in the waters of that region; among them occur such boreal forms as *Mya arenaria*, *M. truncata*, *Yoldia limatula*, *sapotella*, etc., and Dall states:

* Notes on the Miocene and Pliocene of Gay Head, Martha's Vineyard, etc. Amer. Jour. Sci. XLVIII., October, 1894, p. 296.

“It will be observed that this is a distinctly northern assemblage; any of the species might be at home in the waters about Gay Head to-day, as far as we can judge by analogy in the case of extinct species.”

It would appear, then, from the evidence thus far obtained, and taking into account the abundance of *Archaeoplax*, that the climate of the miocene of Gay Head, or at least the temperature of the ocean, was probably somewhat warmer, but yet not greatly different from what it now is south of Cape Cod.

PLATE I. *Cancer proavitus*.

FIGURE 1. From above, nat. size.

“ 2. From below.

“ 3. Hand of a larger specimen.

“ 4. *Archaeoplax signifera* Stm., carapace from above, nat. size.

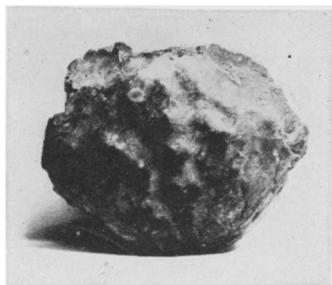


Fig. 1



Fig. 2



Fig. 3



Fig. 4

PLATE II. *Archaeoplax signifera*.

- FIGURE 1. Carapace from above, nat. size.
“ 2. Sterna of two individuals.
“ 3. Four legs, showing the very long fourth joints.



Fig. 1

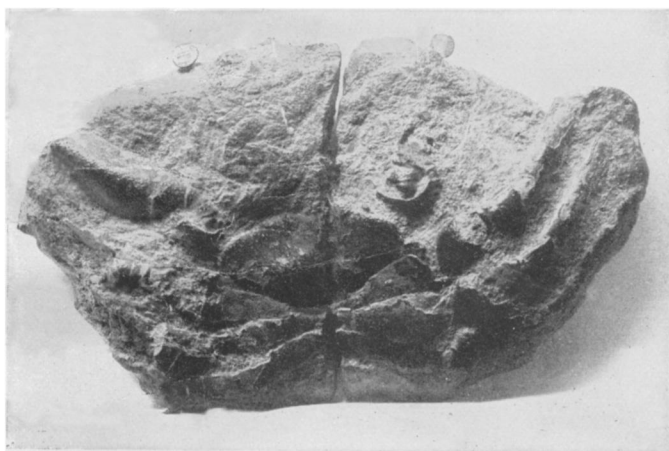


Fig. 2

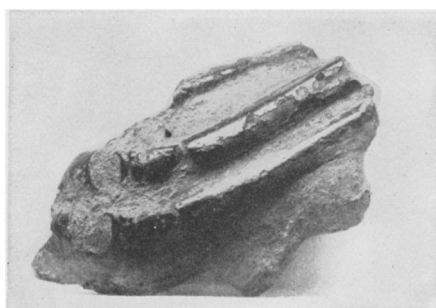


Fig. 3